



Armed Forces Pest Management Board

Disease Vector Ecology Profile

Somalia

Fourth Edition - 15 September 1993

PREFACE

Disease Vector Ecology Profiles (DVEPs) are concise summaries of vector-borne and other militarily significant diseases that occur in specific countries. DVEPs focus on vector-borne diseases and emphasize essential epidemiology, vector bionomics, behavior, and pesticide resistance. Selected bibliographies of pertinent disease and disease vector literature are included.

DVEPs are compiled from unclassified literature and are intended to provide a historical profile of arthropod-borne disease epidemiology in the recent past for selected geographical areas.

The epidemiology of arthropod-borne disease is constantly changing, especially in Third World countries undergoing rapid development and ecological change and those areas experiencing migrations of large refugee populations as a result of civil strife. Therefore, DVEPs should be supplemented with recent information on foreign public health status and medical developments.

Current disease risk assessments, additional information on other parasitic and infectious diseases, and other aspects of medical intelligence can be obtained from the Armed Forces Medical Intelligence Center (AFMIC), Fort Detrick, Frederick, MD 21701, (301) 619-7574, DSN 343-7511.

Additional information can be obtained from the Navy Preventive Medicine Information System (NAPMIS) which maintains up-to-date Disease Risk Assessment Profiles (DISRAPs) and Disease Vector Risk Assessment Profiles (VECTRAPS) on most countries of the world. DISRAPs and VECTRAPS can be obtained by contacting the Navy Environmental Health Center (NEHC), (804) 444-7575 extension 456, DSN 564-7575 ext 456.

DoD Component Medical Department Activities may have updated regional information for their areas of responsibility.

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Taxonomic support assistance and identification keys can be provided by the Walter Reed Army Biosystematics Unit, Museum Support Center, Silver Hill, MD (301) 238-3165. DVEPs are designed to complement documents obtained from AFMIC and NEHC. Every effort is made to ensure their accuracy. Please provide your additions, corrections, or suggestions to Chief, DPMIAC.

DPMIAC Services. In addition to DVEPs, DPMIAC can provide bibliographic literature searches of its extensive database on pest management, medical entomology, pest identification and pesticide toxicology. DPMIAC can also conduct on-line computer searches of other worldwide biomedical databases. DPMIAC publishes the [Technical Information Bulletin \(TIB\)](#), [Technical Information Memoranda \(TIM\)](#), and the Military Pest Management Handbook. Telephone (301) 295-7476, DSN 295-7476.

DPMIAC operates an electronic bulletin board system (BBS) that can be accessed through BBS computer modem. The BBS has products of current operational interest and recent editions of the Technical Information Bulletin (TIB) available for downloading to customer computer stations. The BBS phone number

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SOMALIA

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Note: This document has been modified from its printed version by removal of evaluated medical intelligence for placement on this world wide web server.



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Introduction

The Somali Democratic Republic is located on the east coast of Africa. Shaped roughly like the numeral seven, this Texas-sized country at the apex of the Horn of Africa is bordered by the Gulf of Aden on the north, the Indian Ocean on the east and south, and Djibouti, Ethiopia and Kenya on the west.

Except for rugged east-west mountains peaking at 7,900 feet in the extreme north, the topography mostly consists of low plains. The climate is continuously hot (except for the far north), with spring and fall wet seasons that provide less than 20 inches of rain. Droughts are common and only two major rivers in the south have a permanent flow.

The population of 6.9 million (recent estimate) is remarkably homogeneous, with Somalis accounting for 99% of the people. An additional one million ethnic Somalis live in neighboring countries. Somalia is an extremely poor country in which nomadic or seminomadic animal tenders constitute 60% of the population. This segment of the population lives in shelters made from portable mats. Additionally, 25% of the population are settled farmers who live in mud huts. Six hundred thousand Somalis live in the capital, Mogadishu. Four other cities have more than 50,000 residents: Berbera (65K), Chisimayu (70K), Hargeysa (70K), and Merca (60K).

Because of its harsh arid land, Somalia has been isolated from medical care and research. In 1961 there were "no data" available for Somalia on 22 of the 23 maps compiled by WHO on world distribution of diseases. Ten years later there were still no vital statistics, and information has remained sketchy up to the present.

A high incidence of disease is aggravated by poor nutrition, a difficult environment, primitive water distribution and sanitation, and insufficient medical care. The lack of roads, coupled with a large nomadic population, which both spreads disease and is unavailable for medical attention, contributes to the problem. The average adult Somali has survived an infant mortality rate of 18% and faces a life expectancy of 41 years punctuated by a variety of infectious and parasitic diseases which account for 1/3 - 2/3 of all morbidity.

During the rainy season (April-June), the entire population is at risk of contracting malaria. Between 12,000 and 200,000 people are stricken annually, particularly in the south where the disease persists year-round. In the north, the incidence is high from November through May. *Anopheles arabiensis* and *An. gambiae* are the principal vectors, surviving the dry season in wells and other water-holding containers. *An. funestus* is a vector that transmits malaria in lowland areas near rivers and permanent water sources. *An. merus* breeds in salt water lagoons and transmits malaria along coastal areas.

At least 75% of the population suffers from one or more types of intestinal parasites, with the schistosomiasis rate approaching 100% in some riverine areas. Also endemic are tuberculosis, other respiratory infections, sexually transmitted diseases, leprosy, poliomyelitis, leptospirosis, hepatitis, Rift Valley fever, leishmaniasis, Crimean-Congo hemorrhagic fever, African tick typhus, filariasis, dengue, yellow fever, West Nile fever, onchocerciasis, louse-borne typhus, relapsing fever, soil-transmitted helminths, and a variety of skin and eye diseases.

Mosquito-Borne Diseases

MALARIA

INFECTIOUS AGENTS: *Plasmodium falciparum*, *P. malariae*, *P. vivax*

VECTOR TRANSMISSION: Transmitted by the bite of infected *Anopheles* mosquitoes.

Primary Vectors: *Anopheles arabiensis* and *An. gambiae* are the principal vectors countrywide. *An. funestus* occurs in low-lying areas and *An. merus* in brackish coastal areas.

Other Potential Vectors:

An. azaniae - Sanaag, Togdheer, Woqooyi Galbeed

An. cinereus - Woqooyi Galbeed

An. coustani - Shabeellaha Dhexe, Shabeellaha Hoose

An. daudi - Galguduud, Shabeelle River

An. demeilloni - Woqooyi Galbeed

An. dthali - Bari, Nugaal, Sanaag, Togdheer

An. macmahoni - Bari, Nugaal

An. paludis - Shabeellaha Hoose

An. pharoensis - Gedo, Shabeellaha Dhexe, Shabeellaha Hoose

An. pretoriensis - Sanaag, Togdheer, Woqooyi Galbeed

An. rhodesiensis - Bay, Sanaag, Togdheer, Woqooyi Galbeed

An. salbaii - Gedo

An. sergentii - Woqooyi Galbeed

An. somalicus - Shabeellaha Dhexe, Shabeellaha Hoose

An. squamosus - Bakool, Jubbada Dhexe, Jubbada Hoose, Shabeellaha Dhexe

An. tenebrosus - Shabeellaha Dhexe

An. turkhudi - Sanaag, Togdheer, Woqooyi Galbeed

VECTOR BIONOMICS: *An. arabiensis* breeds in ground pools, tanks, wells, water storage bags and other places. In the north it survives the dry season in covered water containers. No evidence of estivation has been reported. *An. gambiae* requires cleaner, more extensive breeding areas, and hence occurs in rainy periods or wet areas. Breeds in ground pools. Mosquitoes spread widely during the heavy rainy season (APR-JUN). After biting, *An. arabiensis* rests outdoors more so than *An. gambiae*. *An. funestus* is usually found along large rivers and in permanent water. Occurs along the Shabeelle River and southward, but also in Bakool and Woqooyi Galbeed. Control by spraying hut interiors is difficult due to frequent dismantling and turning of woven mat floors and walls. *An. merus* occurs in salt water lagoons of Jubbada Hoose.

DENGUE FEVER

INFECTIOUS AGENT: Virus (Flaviviridae, *Flavivirus*)

VECTOR TRANSMISSION: Transmitted by the bite of infected *Aedes* mosquitoes.

Primary Vector: *Aedes aegypti*

Potential Vectors: *Ae. africanus*, *Ae. caspius*

VECTOR BIONOMICS: *Ae. aegypti* is commonly found breeding in water storage containers, especially in coastal areas near Mogadishu. Females normally deposit eggs near waterline. Eggs can withstand desiccation up to a year. When wet, eggs hatch quickly. Larval stages last about a week. The pupal stage is quite brief and adults may emerge in large numbers. Females are inconspicuous biters. The flight range is generally less than 150 meters. *Ae. caspius* breeds in ground pools, often in polluted, brackish water. *Ae. africanus* is a sylvan species that breeds in rot-holes, bamboo stumps, or manmade containers.

RIFT VALLEY FEVER

INFECTIOUS AGENT: Virus (Bunyaviridae, *Phlebovirus*)

VECTOR TRANSMISSION: Transmitted by the bite of infected *Culex* mosquitoes and contact with slaughtered infected animals.

VECTOR BIONOMICS: [See Filariasis](#)

YELLOW FEVER

INFECTIOUS AGENT: Virus (Flaviviridae, *Flavivirus*)

VECTOR TRANSMISSION: Transmitted by the bite of infected *Aedes* mosquitoes.

Primary Vector: *Ae. aegypti*

Secondary Vectors: *Ae. africanus*, *Ae. vittatus*

VECTOR BIONOMICS: [See Dengue](#)

WEST NILE AND SINDBIS FEVER

INFECTIOUS AGENTS: Virus (Flaviviridae, *Flavivirus* & Togaviridae, *Alphavirus*)

VECTOR TRANSMISSION: Transmitted by the bite of infected *Culex* mosquitoes.

VECTOR BIONOMICS: [See Filariasis](#)

CHIKUNGUNYA FEVER

INFECTIOUS AGENT: Virus (Togaviridae, *Alphavirus*)

VECTOR TRANSMISSION: Transmitted by the bite of infected *Aedes* mosquitoes.

VECTOR BIONOMICS: [See Dengue](#)

FILARIASIS

INFECTIOUS AGENT: *Wuchereria bancrofti*

VECTOR TRANSMISSION: Transmitted by the bite of infected mosquitoes.

Vectors/Potential Vectors: *Culex pipiens*, *Cx. quinquefasciatus*, other *Culex*, *Aedes*, *Anopheles* spp.

VECTOR BIONOMICS: *Culex* mosquitoes usually breed in standing foul water and in various containers, such as ditches, cesspools, etc. Life cycle requires about 10-14 days. Adults enter human habitations and bite at night.

Fly - Associated Diseases

ENTERIC DISEASES

INFECTIOUS AGENTS: a variety of organisms, primarily bacteria and protozoa.

VECTOR TRANSMISSION: Fecal-oral route is the normal mode of transmission; house flies and other filth flies are implicated in amplifying outbreaks. Cockroaches may also serve as mechanical vectors. The house fly, *Musca domestica*, and filth flies, *M. sorbens* and *M. biseta*, are the most likely mechanical vectors.

VECTOR BIONOMICS: House flies and related flies lay their eggs on or in moist organic matter, including garbage, excrement and cadavers. Upon hatching, larvae feed on and develop within the organic material. After roughly one week, mature larvae leave the breeding site and pupate in the surrounding substrate. Adults exit the puparium in 4-5 days. Developmental time for the life stages is temperature dependent. Given their reproductive potential and the high temperatures of Somalia, fly populations can rapidly explode.

MYIASIS

INFECTIOUS AGENTS: Juvenile stages (maggots) of flies; several species involved.

VECTOR TRANSMISSION:

Primary vector: *Cordylobia anthropophaga*

Other potential vectors: Calliphoridae, Muscidae, Sarcophagidae

VECTOR BIONOMICS: *Cordylobia anthropophaga* "tumbu fly" larvae enter the skin and cause a boil-like eruption. Females deposit their eggs in batches of 100-300, usually in dry sand that has been soiled with urine or feces. Larvae hatch and seek a host. Once on the host, larvae burrow into subcutaneous tissues. Penetration is essentially painless. Larvae leave the host and pupate in soil.

NOTE: Tumbu flies lay eggs on underwear hung outside to dry. Hot-ironing may destroy the eggs. Permethrin-treated uniforms will deter egg-laying by flies.

Fly-Borne Diseases

VISCERAL LEISHMANIASIS (Kala-azar)

INFECTIOUS AGENT: *Leishmania donovani*

VECTOR TRANSMISSION: Transmitted by the bite of infected sand flies. The primary vector in Somalia is unknown.

Primary vector: not established

Potential vectors: *Phlebotomus aculeatus*, *P. bergeroti*, *P. dolichopus* (early sand fly taxonomic work questionable), *P. duboscqi*, *P. guggisbergi*, *P. martini* complex (*martini*, *celiae*, *vansomerenae*), *P. orientalis*, *P. pedifer*, *P. sergenti*, *P. somaliensis*, *Sergentomyia clydei*, *S. schwetzi*.

VECTOR BIONOMICS: Larval habitats: Dark, humid places with organic material (excrement, decaying plant material and other debris). Eggs hatch in 1-3 weeks. Larval stage 4-6 weeks. Often associated with termite mounds. Biting habits: Females normally feed at night. Sand flies rarely fly more than 150 meters from breeding sites. Adult activity: Adults active at night and when there is little or no wind. During the day, they rest in sheltered places, such as dark corners of buildings and small crevices.

CUTANEOUS LEISHMANIASIS (Oriental sore)

INFECTIOUS AGENT: *Leishmania tropica* is the probable agent.

VECTOR TRANSMISSION: Transmitted by the bite of infected sand flies. Potential *Phlebotomus* vectors are present.

VECTOR BIONOMICS: [See Visceral Leishmaniasis](#)

SANDFLY FEVER

INFECTIOUS AGENT: Virus (Bunyaviridae, *Phlebovirus*)

VECTOR TRANSMISSION: Transmitted by the bite of infected sand flies. For vector species, [see Leishmaniasis](#).

VECTOR BIONOMICS: [See Leishmaniasis](#)

ONCHOCERCIASIS

INFECTIOUS AGENT: *Onchocerca volvulus*

VECTOR TRANSMISSION: Transmitted by the bite of infected female black flies.

Primary vector: *Simulium damnosum* complex. This complex has been reported from southern Somalia and is anthropophilic.

VECTOR BIONOMICS: Black flies usually lay their eggs in or near fast-moving water. Larvae feed on organisms and organic materials in the water and attach themselves to plants or other objects. After pupation, adults emerge and seek mammalian hosts for blood meals.

TRYPANOSOMIASIS

INFECTIOUS AGENT: *Trypanosoma brucei*, *T. congolense* (in bovids), *T. vivax* (in bovids)

VECTOR TRANSMISSION: Transmitted by the bite of infected tsetse flies.

Suspected vector: *Glossina pallidipes*

Potential vectors: *G. brevipalpus*, *G. longipennis*

VECTOR BIONOMICS: *G. pallidipes* feeds primarily on bovids, often at night. It's a known human vector in other parts of Africa and may also be a vector in Somalia.

Tsetse fly females incubate a single larva internally. Late third-instar larvae are deposited after 8-14 days and pupate in shaded areas. Adults emerge in 3-4 weeks. Absence of large shaded areas in Somalia has apparently limited suitable habitats to the southern river valleys.

Louse-Borne Diseases

EPIDEMIC TYPHUS

INFECTIOUS AGENT: *Rickettsia prowazekii*

VECTOR TRANSMISSION: Through contamination of the bite site by louse feces or crushed lice and possibly by inhalation of infective louse feces in dust.

Primary Vector: *Pediculus humanus humanus*

Potential Vector: *Pediculus humanus capitis*

VECTOR BIONOMICS: Lice are favored by poor sanitary conditions and sharing of clothing and blankets. Eggs of *P. h. humanus* are glued to clothing seams, while those of *P. h. capitis* are attached to hair shafts. Eggs hatch in 8-10 days, and mature lice appear in 8-9 days. Adult lice live up to 40 days and, while tolerant of cold, are very sensitive to temperatures above 110 oF .

RELAPSING FEVER

INFECTIOUS AGENT: *Spirochete bacterium, Borrelia recurrentis*

VECTOR TRANSMISSION: Transmitted by crushing infected lice at bite sites.

Primary Vector: *Pediculus humanus humanus*

Potential Vector: *Pediculus humanus capitis*

VECTOR BIONOMICS: [See Epidemic Typhus](#)

Flea-Borne Diseases

PLAGUE

INFECTIOUS AGENT: *Yersinia pestis*

VECTOR TRANSMISSION: Transmitted primarily by the bite of infected fleas. Other modes of transmission include rubbing crushed fleas or their feces into skin abrasions.

Primary Vector: *Xenopsylla cheopis* (Oriental rat flea)

Secondary/Potential Vector: *Pulex irritans* (human flea)

VECTOR BIONOMICS: Eggs are deposited in or near rodent nests. Larvae feed on nest debris and pupate in loose cocoons near the nest area. Adults emerge and seek blood meals from rodent hosts. When a host dies, fleas leave and seek a new host. If humans happen to be near, fleas will attack and infect them. Thus, in plague operations, flea control must precede rodent control.

MURINE TYPHUS

INFECTIOUS AGENT: *Rickettsia typhi*

VECTOR TRANSMISSION: Transmitted when infective flea feces are scratched into the skin or by inhalation of dried feces in dust.

Primary Vector: *Xenopsylla cheopis*

Potential Vector: *Ctenocephalides felis*

VECTOR BIONOMICS: [See Plague](#)

Tick-Borne Diseases

ARBOVIRUSES (Miscellaneous)

CRIMEAN-CONGO HEMORRHAGIC FEVER

INFECTIOUS AGENT: Virus (Bunyaviridae, *Nairovirus*)

VECTOR TRANSMISSION: Bite of infected ixodid (hard) ticks or exposure to infected animals (sheep, goats, cattle) or humans.

Vectors/Potential Vectors: *Amblyomma variegatum*, *Boophilus decoloratus*, *Hyalomma anatolicum anatolicum*, *Hy. impeltatum*, *Hy. rufipes*, *Hy. truncatum*, *Rhipicephalus pulchellus*

VECTOR BIONOMICS: Ticks are associated with many habitat types and are found throughout Somalia. Numerous large and small animals, wild and domestic, serve as hosts. Tick infestations may be acquired year-round and in virtually all localities.

AFRICAN TICK TYPHUS

INFECTIOUS AGENT: *Rickettsia conorii*

VECTOR TRANSMISSION: Bite of an infected ixodid (hard) tick.

Vectors: *Hyalomma* and *Rhipicephalus* spp. are the likely vectors, but virtually any ixodid tick may transmit this disease.

VECTOR BIONOMICS: [See above](#)

TICK-BORNE RELAPSING FEVER

INFECTIOUS AGENT: *Spirochete bacterium*, *Borrelia recurrentis*

VECTOR TRANSMISSION: Bite of an infected argasid (soft) tick or by contact with infectious tick coxal fluids, which enable the spirochete to penetrate even unbroken skin.

Vectors: *Ornithodoros* spp.

VECTOR BIONOMICS: Argasid ticks are secretive and usually feed at night. They engorge rapidly and then leave their host. The various species of *Ornithodoros* are exceptionally long-lived and serve as reservoirs of disease.

Snail-Borne Disease

SCHISTOSOMIASIS

INFECTIOUS AGENT: *Schistosoma haematobium* (Urinary schistosomiasis)

VECTOR TRANSMISSION: Intermediate Host: *Bulinus abyssinicus*

Other species of *Bulinus*, subgenera *Bulinus* and *Physopsis*, may also transmit the disease. Humans acquire infection by working, bathing, etc. in infected water. Cercariae in water attach to and penetrate skin. Although infection rates in snails are low (1-2%), transmission to humans occurs readily because each infected snail releases thousands of cercariae. Exposure to freshwater impoundments, especially in southern agricultural areas, should be avoided.

VECTOR BIONOMICS: Infected snails are found in reservoirs, depressions, other bodies of standing water, and in water used for domestic purposes, such as clothes washing, bathing, etc. Snails can be carried into remote areas in water containers and in mud on the legs of camels, cattle, and birds. They are usually not found in moving water, such as irrigation canals, but may become established along the banks of rivers. Snails survive dry seasons by burrowing beneath riverbeds and other areas where standing water does not completely dry up.

Appendix A. Ticks of Somalia

- *Amblyomma cohaerens*
- *Amblyomma falsomarmoreum*
- *Amblyomma gemma*
- *Amblyomma lepidum*
- *Amblyomma marmoreum*
- *Amblyomma nuttalli*
- *Amblyomma rhinocerotis*
- *Amblyomma sparsum*
- *Amblyomma variegatum*

- *Aponomma exornatum*

- *Argas persicus*

- *Boophilus decoloratus*

- *Dermacentor rhinocerinus*

- *Haemaphysalis calcarata*
- *Haemaphysalis leachi*

- *Hyalomma anatolicum anatolicum*
- *Hyalomma anatolicum excavatum*
- *Hyalomma dromedarii*
- *Hyalomma erythraeum*
- *Hyalomma impeltatum*
- *Hyalomma marginatum marginatum*
- *Hyalomma marginatum turanicum*
- *Hyalomma punt*
- *Hyalomma rufipes*
- *Hyalomma truncatum*

- *Ornithodoros acinus*
- *Ornithodoros porcinus*
- *Ornithodoros savignyi*

- *Rhipicephalus appendiculatus*
 - *Rhipicephalus armatus*
 - *Rhipicephalus camicasi*
 - *Rhipicephalus evertsi evertsi*
 - *Rhipicephalus humeralis*
 - *Rhipicephalus longicoxatus*
 - *Rhipicephalus pravus*
 - *Rhipicephalus pulchellus*
 - *Rhipicephalus sanguineus*
 - *Rhipicephalus simus*
-

Appendix B. Sand Flies of Somalia

- *Phlebotomus aculeatus*
- *Phlebotomus arabicus*
- *Phlebotomus bergeroti*
- *Phlebotomus duboscqi*
- *Phlebotomus martini*
- *Phlebotomus orientalis*
- *Phlebotomus papatasi*
- *Phlebotomus pedifer*
- *Phlebotomus sergenti*
- *Phlebotomus somaliensis*

- *Sergentomyia affinis*
- *Sergentomyia africanus africanus*
- *Sergentomyia africanus magnus*
- *Sergentomyia attenatus*
- *Sergentomyia bedfordi*
- *Sergentomyia calcarata*
- *Sergentomyia choumarai*
- *Sergentomyia christopherei*
- *Sergentomyia clydei*
- *Sergentomyia decipiens*
- *Sergentomyia dolichopus*
- *Sergentomyia durenii*
- *Sergentomyia fallax*

- *Sergentomyia inermis*
 - *Sergentomyia ingrami*
 - *Sergentomyia multidens*
 - *Sergentomyia palestinensis lewisi*
 - *Sergentomyia squamipleuris*
 - *Sergentomyia schwetzi*
 - *Sergentomyia tiberiadis*
-

Appendix C. Mosquitoes of Somalia

(Principal Vector Genera)

- *Aedes aegypti*
- *Aedes africanus*
- *Aedes albicostis*
- *Aedes caspius*
- *Aedes fowleri*
- *Aedes hirsutis*
- *Aedes natronius*
- *Aedes sudanensis*
- *Aedes vexans*
- *Aedes vittatus*

- *Anopheles arabiensis*
- *Anopheles azaniae*
- *Anopheles cinereus*
- *Anopheles coustani*
- *Anopheles culicifacies*
- *Anopheles daudi*
- *Anopheles demeilloni*
- *Anopheles dthali*
- *Anopheles funestus*
- *Anopheles gambiae*
- *Anopheles merus*
- *Anopheles paludis*
- *Anopheles pharoensis*

- *Anopheles pretoriensis*
- *Anopheles rhodesiensis*
- *Anopheles salbairi*
- *Anopheles sergentii*
- *Anopheles somalicus*
- *Anopheles squamosus*
- *Anopheles tenebrosus*
- *Anopheles turkhudi*

- *Culex annulioris*
- *Culex antennatus*
- *Culex bitaeniorhynchus*
- *Culex decens*
- *Culex duttoni*
- *Culex inconspicuus*
- *Culex laticinctus*
- *Culex neavei*
- *Culex nebulosus*
- *Culex perexiguus*
- *Culex pipiens*
- *Culex poicilipes*
- *Culex quinquefasciatus*
- *Culex salisburyensis*
- *Culex simpsoni*
- *Culex sinaiticus*
- *Culex sitiens*
- *Culex thalassius*
- *Culex theileri*
- *Culex tigripes*
- *Culex tritaeniorhynchus*
- *Culex univittatus*

- *Culiseta longiareolata*

Appendix D. Other Flies of Potential Medical Importance

- Calliphoridae
 - *Calliphora* spp.
 - *Chrysomya bezziana* (Old World screwworm)
 - *Cordylobia anthropophaga* (Tumbu fly)
 - *Cordylobia rodhaini*
 - *Lucilia* spp.
 - *Phaenicia* spp.

- Sarcophagidae
 - *Sarcophaga* spp.
 - *Wohlfahrtia magnifica*

- Oestridae
 - *Gasterophilus* spp.
 - *Hypoderma* spp.
 - *Oestrus ovis*

- Muscidae
 - *Fannia canicularis*
 - *Fannia scalaris*
 - *Haematobia* spp.
 - *Musca autumnalis*
 - *Musca domestica*
 - *Musca sorbens*
 - *Ophyra* spp.
 - *Stomoxys calcitrans*

- Chloropidae
 - *Hippelates* spp.

- Hippoboscidae
 - *Hippobosca* spp.

- Simuliidae
 - *Simulium damnosum*
 - *Simulium ruficorne*

- Tabanidae
 - *Ancala* spp.

- *Haematopota coronata*
 - *Neavella spp.*
 - *Tabanus mordax*
 - *Tabanus morsitans*
 - *Tabanus sufis*
 - Ceratopogonidae
 - Species lists unavailable
 - Glossinidae
 - *Glossina brevipalpus*
 - *Glossina longipennis*
 - *Glossina pallidipes*
-

Appendix E. Lice, Fleas and Mites of Potential Medical Importance

- Anoplura
 - *Pediculus humanus capitis*
 - *Pediculus humanus humanus*
 - *Pthirus pubis*
 - Acari
 - *Sarcoptes scabiei*
 - Siphonaptera
 - *Ctenocephalides felis*
 - *Pulex irritans*
 - *Xenopsylla cheopis*
-

Appendix F. Personal Protective Measures

Personal protective measures are the first line of defense against arthropod-borne disease and may be the only protection for military personnel deployed in the field. Proper wearing of the uniform and appropriate use of repellents can provide high levels of protection against blood-sucking arthropods. The

uniform fabric is a significant mechanical barrier to mosquitoes and other blood-sucking insects. The uniform should be worn to cover as much skin as possible if weather and physical activity permit. When operating in tick-infested areas, the pants should be bloused into the boots to prevent access to the skin by ticks and other crawling arthropods such as chiggers. Check yourself frequently when walking through tick-infested areas. Upon returning from tick-infested areas, remove all clothing and examine yourself for ticks. Infected ticks may require several hours of feeding before pathogens are transmitted. Therefore, personnel who operate in tick-infested areas should check themselves frequently for ticks and remove them as soon as possible. If ticks become attached, the simplest and best method of removal is by a slow, steady pull with a pair of tweezers or forceps. Do not squeeze the body but grasp the tick where the mouthparts enter the skin and pull firmly until the tick is extracted. Be careful not to break off the mouthparts and leave them in the skin. Wipe the bite area with an antiseptic. If hands have touched the tick during removal, wash them thoroughly with soap and water or an antiseptic, since tick secretions may contain pathogens.

Newly developed repellents provide military personnel with unprecedented levels of protection. An aerosol formulation of permethrin (NSN 6840-01-278-1336) can be applied to the uniform according to label directions but not to the skin. This will provide the uniform material with both repellent and insecticidal properties that will be retained through five washings. A new extended-duration repellent lotion (cream) of DEET (N, N-diethyl-3-methylbenzamide, formerly N, N-diethyl-m-toluamide) (NSN 6840-01-284-3982) has been developed to replace the 2 oz. bottles of 70% DEET in alcohol. The new formulation contains 34% active ingredient. It is less irritating to the skin, has less odor, and is generally more acceptable to the user. Combined with proper wearing of the uniform, use of extended duration DEET on exposed skin and permethrin on uniform items has been demonstrated in laboratory and field studies to provide nearly 100% protection against a variety of blood-sucking arthropods. In addition, permethrin should be used to treat bednets, tentage, and other field items as appropriate. Detailed descriptions and instructions on the proper use of personal protective items, with training slides, are provided in Army Environmental Hygiene Agency Technical Guide No. 174: Personal Protective Techniques Against Insects and Other Arthropods of Military Significance. Order this publication from DPMIAC.

Appendix G. Chemical Control of Pests and Vectors

More detailed recommendations for the selection, application and use of pesticides in field situations worldwide, during contingency operations or military exercises, can be found in AFPMB [Technical Information Memorandum \(TIM\) No. 24](#), "Contingency Pest Management Pocket Guide." This guide is a concise reference to National Stock Number (NSN)- listed pesticides and equipment available through military supply channels for contingency use. It covers intended uses, dosages, and application methods, pesticide dilution and dosage formulas, and pesticide dispersal equipment. TIM 24 also provides information on surveillance, trapping, and safety equipment, personal protective equipment against disease vectors, air-transport of pesticides that don't meet transportation requirements, and US military points of contact overseas who can provide information on vector-borne disease control in their respective areas of the world.

Copies of TIM-24, Contingency Pest Management Pocket Guide, can be obtained free of charge from:

Defense Pest Management Information Analysis Center
Armed Forces Pest Management Board
Forest Glen Section, WRAMC

Appendix H. Pesticide resistance Data

Few tests on pesticide resistance have been reported from Somalia. Those reports available indicate that *Aedes aegypti* is resistant to diazinon but is susceptible to other organophosphates and to DDT and dieldrin. *Anopheles arabiensis* and *An. gambiae* are susceptible to organophosphates such as malathion and fenitrothion. While there is no reported resistance of *An. arabiensis* or *An. gambiae* to DDT or dieldrin in Somalia, resistance is widespread in Ethiopia and is likely to be present in Somalia. Similarly, there are no reports of resistance in *Pediculus humanus* or *Culex quinquefasciatus* in Somalia, but similar patterns of use in Ethiopia have produced lindane resistance in *P. humanus* and DDT and fenthion resistance in *Cx. quinquefasciatus*. Consequently, it is likely that some degree of resistance to these compounds occurs in the same species in Somalia. However, the levels of resistance probably are insufficient to cause total control failure.

Appendix I. Snakes of Somalia

Note: Color photographs of most of the poisonous snakes of Somalia are available in AFMIC-1810R-058-92, Operation Restore Hope: Health Risks and Countermeasures in Somalia.

COLUBRIDAE

Dispholidus typus, the boomslang. This arboreal species is thought to occur only in western Somalia. Prominent colors are green and brown, with some dark mottling. This snake may be confused with the spotted bush snake. The boomslang has prominent eyes in a short, pointed head. It is slender, normally reaching a length of about 5 feet. The boomslang, although potentially quite deadly, usually bites only after being severely provoked. When annoyed, its throat inflates to twice the normal size. The venom, once injected, is quite potent and dangerous. A specific antivenin is available from the South African Institute of Medical Research, Johannesburg.

Atractaspis microlepidota, the mole viper. This burrowing species is not a true viper. It is a small snake, with colors ranging from gray to brown or black. The head is small and not distinct from the neck. It spends most of its time underground, except in the rainy season. Venom is hemotoxic, with no antisera available. The amount of venom injected is normally sublethal for an adult.

ELAPIDAE

Naja naja, the Egyptian cobra. This large snake grows up to 8 feet in length. It is usually a dull brown or gray with a yellowish ventral side. This species occurs in semi-arid or savanna habitat in northern Somalia. While usually nocturnal, it may be seen basking by day. It may also enter houses in search of

food. This snake is quiet but inquisitive, becoming aggressive when restricted. Once cornered, it may strike with little provocation, delivering a large quantity of potent venom, to which there is a polyvalent antiserum (Pasteur Institute).

Two spitting cobra species, *Naja nigricollis* and *Naja mossambica*, are reported from Somalia. *Naja nigricollis*, the black-necked cobra, generally occurs in northern areas. It is up to 5 feet long and ranges in color from brown to red to black. The hood is egg-shaped. This species prefers grassland habitats, often living in rock crevices or rodent burrows. It hunts food (toads, other snakes, insects, and rodents) at night, basking in the sun by day. It deters predators by spitting venom in their eyes, with good accuracy up to about 6 feet. This venom must be removed by washing in order to prevent permanent blindness. It also will bite if the threat continues and can inject a lethal dose of venom. *Naja mossambica*, the collared cobra, generally occurs in southern Somalia and ranges in color from orange-red to pink to red, with a dark collar. Its size, habits, habitats, and venom characteristics are similar to *N. nigricollis*, except that it tends to occur in more arid areas, often near human habitations. Bites of both species produce widespread necrosis and require specific spitting cobra antivenin, not nonspecific cobra venom, to neutralize their effects. Antivenin is available from the Pasteur Institute.

Dendroaspis polylepis, the black mamba, is the fastest, largest, and most dangerous of the venomous snakes in the region. It is most often olive brown or metal gray, with a yellow to gray-white ventral aspect. It may attain lengths of up to 14 feet. It occurs primarily in the forest and open bush country of northern Somalia, where it is found in tree stumps, termite mounds, or abandoned animal burrows. This snake often enters homes and food storehouses in search of rodents, its principal food. It can move at speeds over 10 miles per hour. It is easily provoked and will rear up off the ground and strike at a distance up to 40 percent of its length. Its venom is extremely potent and is delivered in large quantity, causing life-threatening toxicity within as little as 15 minutes. There is an antivenin available from the Pasteur Institute which is essential to recovery from envenomization.

VIPERIDAE

Echis carinatus, the saw-scaled or carpet viper, is a small (less than 2 feet), slightly built snake. Its coloration can range from brown to red to buff to gray, with small white dorsal blotches edged with black. It inhabits dry, sandy areas, savanna, or rocky outcroppings, mostly in northern Somalia, generally resting in rodent burrows by day. During rainy periods, it often rests in trees or shrubs. Its normal behavior is to wait and ambush its prey. This behavior puts one at risk of stepping on it, resulting in immediate attack. When encountered, it assumes a figure-8 coil shape, rubbing its scales together to produce a hissing sound. It is an aggressive snake that rarely retreats from an encounter. The snake will often strike several times in quick succession, delivering an exceptionally toxic venom. Soldiers wearing combat boots are usually shielded from the bite of this snake, since its fangs are short and its striking distance is not long. In terms of frequency and potency of bites, this is probably the most dangerous snake in the area. Antivenin is available from the Pasteur Institute.

Causus rhombeatus, the rhombic night adder, and *Causus resimus*, the green night adder, are small stocky snakes that rarely exceed two feet in length. The rhombic night adder is olive or brownish with darker brown or black chevrons. The green night adder is a velvety bright green with dark chevrons dorsally. Both snakes are nocturnal. The rhombic night adder occurs most often in western Somalia, while the green night adder occurs in wet savannas of the southern Somalia coast. Like the carpet viper, these sluggish snakes wait for their prey along paths, making them easy to step on. They hiss when threatened but usually retreat unless cornered. The bites are generally non-lethal for an adult, and no antisera are available.

Bitis arietans, the puff adder, is a wide-bodied snake that may reach a length of 5 feet. The color is brown to grayish, with regular whitish chevrons on the dorsal surface. The head is flattened and less triangular than in most vipers. The puff adder is both nocturnal and diurnal and is widely distributed in Somalia. It prefers semi-arid habitats but often lurks along paths near buildings. It is well camouflaged in its environment, making it easy to step on.

When disturbed, it makes a long, deep hissing noise and then generally strikes rapidly. The puff adder often injects a lethal amount of venom which can be fatal without antivenin. Antivenin is available from the Behring Institut, Germany (06421) 39-0 and Institut Pasteur Production, France (1) 47-41-79-22.

Appendix J. Scorpions of Somalia

Few details are available concerning the preferred habitats and life histories of the scorpions of Somalia. The species in the family Buthidae are small to medium-sized, the maximum length recorded being about 75 mm, with most in the 35 to 50 mm range. The genus *Pandinus*, family Scorpionidae, contains larger species, although even these are mostly in the 75 to 100 mm range. There are apparently no dangerous species represented in either family in Somalia. The sting is like that of a bee. Stinging behavior is normally a defensive action brought on by sudden intrusion into the scorpion's territory.

Scorpions are nocturnal predators with a wide range of prey, from insects and other arthropods for small scorpions to small rodents for the larger species. Scorpions also exhibit thigmotactic behavior, which means they try to maintain surface contact with two or more of their body surfaces as much as possible. In general, they are unobtrusive creatures that occupy secluded habitats during the day, including crevices, animal burrows, rock piles, debris, and even carcasses. They also can very easily move into or under sleeping bags, piles of clothes, and boots, so caution should be used when approaching these items. At night, they actively seek prey. Their activities are readily monitored under ultraviolet light, in which they fluoresce brightly. Apparently, UV light does not disturb their normal activities.

Family Buthidae

- *Buthacus claviceps*
- *Buthus insolitus?*
- *Hottentotta fuscitruncus*
- *Hottentotta polystictus*
- *Hottentotta trilineatus*
- *Lychas obsti*
- *Microbuthus litoralis*
- *Orthochirus aristidus*
- *Uroplectes fischeri typicus*

Scorpionidae

- *Pandinus colei?*
- *Pandinus pallidus*
- *Pandinus phillipsi*
- *Pandinus meidensis?*

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